

Neurobehavioural Effects of Hydrogen Sulphide on Humans

Evaluate human neurobehavioural effects from controlled exposure to hydrogen sulphide

What was the purpose of this project?

Workers and downwind residents of some petroleum and pulp and paper facilities are sometimes exposed to hydrogen sulphide (H₂S). While H₂S is lethal at persistent high concentrations (more than 500 parts per million), little is known about the neurobehavioural effects from ambient or occupational levels. While some believe H₂S has an adverse effect at these low levels, others doubt it has any effect.

A recent U.S. study showed that rats exposed to low levels (around 10 parts per million) of H₂S showed no signs of developmental, neurological or reproductive impairment. But similar research on humans has not been done until now, although a recent review by Alberta Health¹ concluded that little evidence of any effect in humans exists at levels below 10 parts per million.

This project involves exposing, under carefully controlled conditions, human subjects to short periods of hydrogen sulphide at low concentrations and then assessing them for various neurobehavioural effects. Such research should help address health concerns of those who work at or live near sour gas facilities in Alberta. The results could also help determine if existing guidelines for exposure to ambient levels of H₂S are adequate.

How was the project conducted?

The project began in 2002 with the development of a protocol for a pilot study to establish stable exposure concentrations of uniformly-distributed H₂S and to determine testing procedures. A panel of ethicists and scientists, including several from the Universities of Alberta and Calgary, was assembled to ensure the highest ethical standards were met in conducting the research.

< ¹ http://www.health.gov.ab.ca/public/document/H2S_report.pdf

The study, conducted in the United States by the New Jersey-based Environmental and Occupational Health Sciences Institute, involved two phases. In the pilot study, healthy men and women aged 20 to 40 were placed in a stainless steel chamber and exposed for two hours to three H₂S concentrations - 0.05, 0.5 and 5 parts per million. They performed a number of tests and were assessed for symptoms – sensory irritation, cognition, mood and respiratory function – odour response, sensory function and nasal inflammation. The second phase was a larger study.

What are the results?

Seventy-four healthy men and women, with an average age of 24.7, completed the study. After controlling for baseline ratings, dose response reduction in air quality and increases in ratings of odour intensity, irritation, and unpleasantness were observed.

Relative to baseline, total symptom severity was not significantly elevated between exposure conditions, but anxiety symptoms were significantly greater at 5 ppm than at 0.05 ppm. No dose response effect was observed for sensory or cognitive measures. Verbal learning was depressed during each exposure condition, relative to baseline.

Odour and environmental quality ratings reflect a dose response effect of H₂S. Even when significant changes in symptom severity were observed, the changes were relatively minor. Whether the effect on verbal learning represents a threshold effect of H₂S or an effect due to fatigue across exposure remains to be determined.

What happens next?

The study is completed. An additional study may be undertaken to explore the finding of depressed verbal memory in all three exposure conditions. As well, a smaller study may look at a zero exposure condition, which would be compared to 0.05 and 0.5 ppm conditions.

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